Technical Note

Arthroscopic Knotless Modified McLaughlin Procedure for Reverse Hill–Sachs Lesions

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Abstract: Posterior shoulder dislocations often are associated with an impression fracture involving the anterior humeral head known as a reverse Hill–Sachs lesion. These injuries can result in significant bone defects that require surgical management to prevent them from engaging the posterior glenoid. We present a modified arthroscopic, knotless McLaughlin procedure (tenodesis of the subscapularis tendon into the bone defect) for the treatment of small-to medium-sized, engaging Hill–Sachs lesions. The knotless fashion aims to eliminate potential problems associated with knot tying, such as knot migration, knot impingement, and chondral abrasion.

Posterior shoulder dislocations often are associated with an impression fracture involving the anterior humeral head known as a reverse Hill–Sachs lesion.[1] Reverse Hill–Sachs lesions may cause significant clinical symptoms and may increase the risk for re-dislocation, progressive joint destruction, and early osteoarthritis.[2] Similar to anterior shoulder instability, depending on size and location, reverse Hill–Sachs lesions can present risk for persistent posterior glenohumeral instability if untreated. For small-to medium-sized reverse Hill–Sachs lesions, several surgical open and arthroscopic techniques have been described with filling the bone defect by transferring the subscapularis tendon with or without the lesser tuberosity, resulting in reliable clinical outcome and low re-dislocation rate.[3-6] The arthroscopic approach with "tenodesis" of the subscapularis tendon into the bone defect—the so-called McLaughlin procedure—has shown to be advantageous by maintaining the integrity of the subscapularis tendon, a dynamic stabilizer that resists posterior translation.[7]

This Technical Note describes a modified arthroscopic, knotless McLaughlin procedure for the treatment of small-to medium-sized, engaging Hill–Sachs lesions. The knotless fashion aims to eliminate potential problems associated with knot tying, such as knot migration, knot impingement, and chondral abrasion.[8]

Surgical Technique (With Video Illustration)

A detailed video of our knotless arthroscopic modified McLaughlin procedure is shown in Video 1. Pearls and pitfalls of this technique and advantages and disadvantages of this technique are described in Tables 1 and 2, respectively.

Patient Positioning and Anesthesia

Beach chair positioning is used for this technique. It is also possible to use the lateral decubitus position, but beach chair positioning is preferred when performing this surgery, as it allows the surgeon to forward flex the patient's shoulder to relax the anterior deltoid and

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The authors report the following potential conflict of interest or source of funding.

D.L.B. reports nonfinancial support and other from Arthrex, other from Smith & Nephew, other from Siemens, other from Össur, and personal fees from Elite Orthopedics, LLC, outside the submitted work; L.L. has received funds (exceeding the equivalent of US$500) not related to this manuscript. His positions at SPRI were supported by AGA for 1 calendar year, through a grant from Arthrex. B.T.G. reports other from Arthrex, other from Smith & Nephew, other from Siemens, and other from Össur, outside the submitted work. P.J.M. reports grants and personal fees from Arthrex, personal fees from Medbridge, personal fees from Springer Publishing, from VuMedi, other from Smith & Nephew, other from Arthrex, other from Siemens, and other from Össur, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Research was performed at the Steadman Philippon Research Institute, Vail, CO.

Received July 18, 2019; accepted September 2, 2019.

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2212-6287/19920

https://doi.org/10.1016/j.eats.2019.09.002

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Preoperative evaluation should involve a thorough assessment of the anterior humeral head on 3-dimensional imaging to assess for reverse Hill–Sachs lesions in patients presenting with posterior instability, as this is a common lesion in these patients.	Arthroscopic portals not in the plane of the glenohumeral joint will make it difficult to work at the posterior and anterior-most extents of the glenohumeral joint, both of which are necessary in a case of posterior instability requiring reverse Bankart repair and reverse Hill–Sachs remplissage.
Use of a 70° arthroscope can aid in visualization of the reverse Hill–Sachs lesion with the camera in the anterior portal.	Caution must be taken when debriding anterior to the subscapularis tendon to avoid the axillary nerve at the inferior border of the tendon.
Diagnostic scope should be comprehensive and all associated posterior instability lesions should be recognized and treated (e.g. reverse Bankart, posterior capsular laxity, reverse HAGL, reverse Hill–Sachs).	
A meticulous debridement of the subcoracoid recess, particularly anterior to the subscapularis tendon, helps to make suture retrieval easier.	
The number of sutures and suture anchors used for subscapularis remplissage should be based on size of the lesion.	

HAGL, humeral avulsion of the glenohumeral ligament.

provide more working space anteriorly to perform a subscapularis remplissage. Once the patient is upright in the beach chair position, it is important to perform an examination under anesthesia of the affected shoulder as well as the contralateral shoulder for comparison. Anterior and posterior translation should be carefully assessed. The operative extremity, shoulder, and axilla are then prepped and draped using standard sterile technique and the extremity is placed in a mechanical arm holder (e.g. TRIMANO; Arthrex, Naples, FL).

Surgical Approach

A standard posterior portal made approximately 2 cm inferior and 2 cm medial to the posterolateral corner of the acromion, with a spinal needle used to ensure that the trajectory of portal is in the plane of the glenohumeral joint before incising the skin. Under direct visualization, an anterosuperior portal is first established, just anterior and inferior to the clavicle, entering the joint high in the rotator interval. An anteroinferior portal is then established under direct visualization. Typically, the skin incision for the anteroinferior portal is near the level of the coracoid and the spinal needle should enter just superior to the subscapularis tendon. A 5.0-mm cannula is placed in the anterosuperior portal. A 6.0-mm cannula is placed in the anteroinferior portal, as this size of portal is required to allow for insertion of 4.75-mm SwiveLock suture anchor (Arthrex).

Diagnostic arthroscopy is then be performed, with thorough assessment of the posterior capsulolabral complex as well as the anterior humeral head (Fig 1). To better evaluate these areas, it is important to switch the camera to the anterosuperior portal. This allows examination of the size, depth, and location of the bony injury of the anterior humeral head (Fig 2). With the arthroscope in the anterosuperior portal, a posterior drawer examination should be performed to assess posterior translation of the humeral head relative to the glenoid, and the arm should be internally rotated to allow assessment of whether the reverse Hill–Sachs lesion engages the glenoid rim posteriorly.

Although the focus of this manuscript is on the modified McLaughlin procedure, it is crucial to address all concomitant pathology present, including reverse Bankart lesions, humeral avulsion of the glenohumeral ligament lesions, or posterior capsular laxity. To facilitate work on the posterior glenoid, we recommend placement of the arthroscope into the anterosuperior portal and creation of an accessory posterolateral portal.

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
Arthroscopic approach limits incision size	Potential to overconstrain humeral head rotation, although this has not been demonstrated clinically
Not detaching subscapularis tendon or performing lesser tuberosity osteotomy can allow for less postoperative restrictions	Limited to reverse Hill–Sachs lesions smaller than 33% of humeral head volume
Technique removes biomechanically weaker tied knots and increases surgical efficiency by use of knotless fixation	
Technique uses instrumentation and implants commonly used in shoulder arthroscopy	

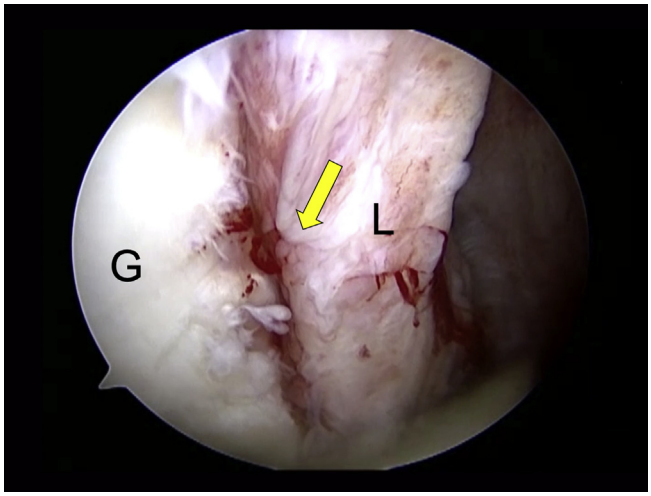

Fig 1. Left shoulder: Arthroscopic visualization of the posterior capsulolabral defect seen through anterosuperior portal. Yellow arrow demonstrates area of capsulolabral separation from the posterior glenoid. (G, glenoid; L, labrum.)

For this reason, it is important that the anterosuperior portal is made in the plane of the glenohumeral joint. While the accessory posterolateral portal is used for concomitant procedures to address posterior instability, it is not used for the subscapularis remplissage itself.

Subscapularis Remplissage

To perform the subscapularis remplissage, the arthroscope is returned to the standard posterior viewing portal. In preparation for subscapularis remplissage, debridement of the rotator interval and subacoracoid space is performed, with particular attention to clearing the space anterior to the subscapularis tendon to facilitate future suture retrieval (Fig 3). Caution must be taken to protect the axillary nerve while creating this space anterior to the subscapularis tendon. After a working space is created, the reverse Hill–Sachs lesion is prepared with a shaver followed by a rasp (Fig 4). These tools are used to create a bleeding bony surface at the base of the anterior bony defect to facilitate healing of the subscapularis tendon to the bone.

To achieve a knotless construct, we first pass our suture through the desired location in the subscapularis tendon. A spinal needle is inserted percutaneously, passing through the space created anterior to the subscapularis and then into the subscapularis tendon medial to its attachment point on the lesser tuberosity

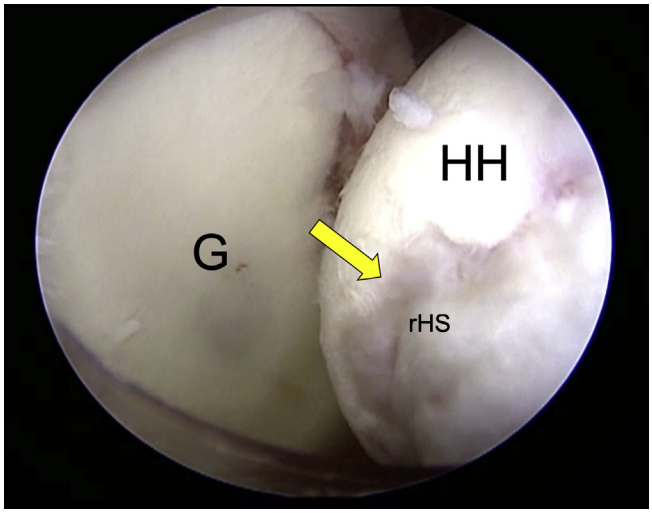

Fig 2. Left shoulder: Arthroscopic visualization of the anterior, humeral reverse Hill–Sachs lesion seen through anterosuperior portal. Yellow arrow points to the reverse Hill–Sachs lesion of the anterior humeral head. (G, glenoid; HH, humeral head; rHS, reverse Hill–Sachs lesion.)

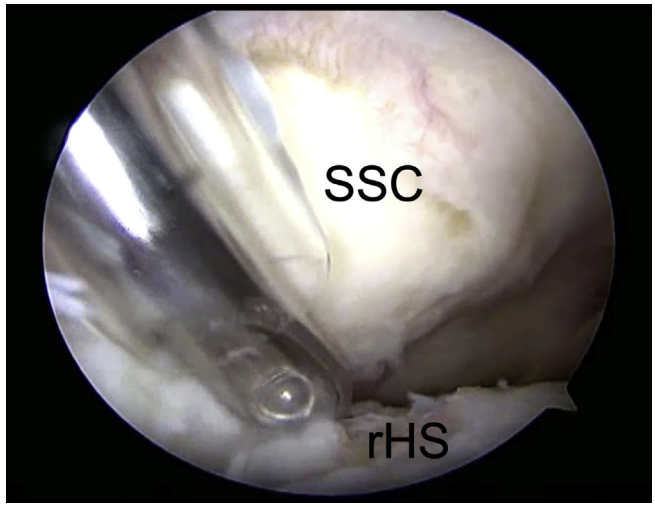

Fig 3. Left shoulder: Arthroscopic visualization through the posterior portal showing debridement and preparation of the reverse HilleSachs defect with an oscillating shaver to create a denuded surface for healing. (rHS, reverse Hill–Sachs lesion; SSC, subscapularis tendon.)

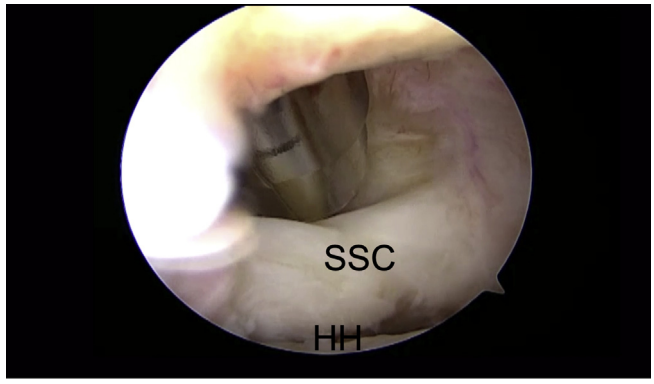

Fig 4. Left shoulder: Arthroscopic visualization through the posterior portal showing debridement of the rotator interval and subacoracoid space, with particular attention to clearing the space anterior to the subscapularis tendon to facilitate future suture retrieval. (HH, humeral head; SSC, subscapularis tendon.)

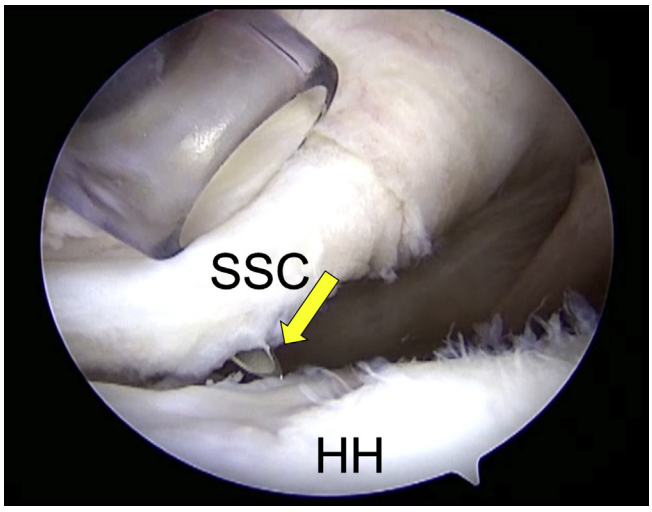

Fig 5. Left shoulder: Arthroscopic visualization through the posterior portal showing the spinal needle inserted percutaneously, passing through the space created anterior to the subscapularis, and then into the subscapularis tendon medial to its attachment point on the lesser tuberosity and in-line with the area of the reverse Hill–Sachs lesion (yellow arrow). (HH, humeral head; SSC, subscapularis tendon.)

and in-line with the area of the reverse Hill–Sachs lesion (Fig 5). A polydioxanone suture is then passed through the spinal needle and retrieved through the anteroinferior portal where the 6-mm cannula had been placed (Fig 6). This polydioxanone suture is then used to shuttle a FiberTape (Arthrex) suture through the subscapularis tendon. The limb of the FiberTape that is exiting the subscapularis tendon anteriorly is then retrieved through the anteroinferior portal using a FiberTape retriever (Arthrex) (Fig 7). This results in

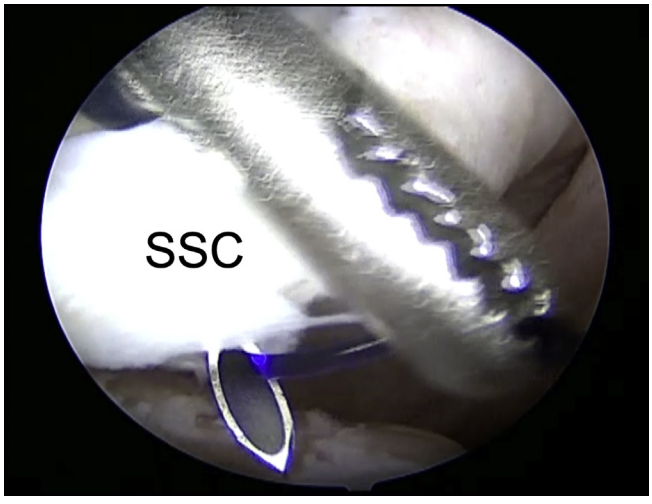

Fig 6. Left shoulder: Arthroscopic visualization through the posterior portal showing the polydioxanone suture passed through the spinal needle and retrieved through the anteroinferior portal, where the 6-mm cannula had been placed. (SSC, subscapularis tendon.)

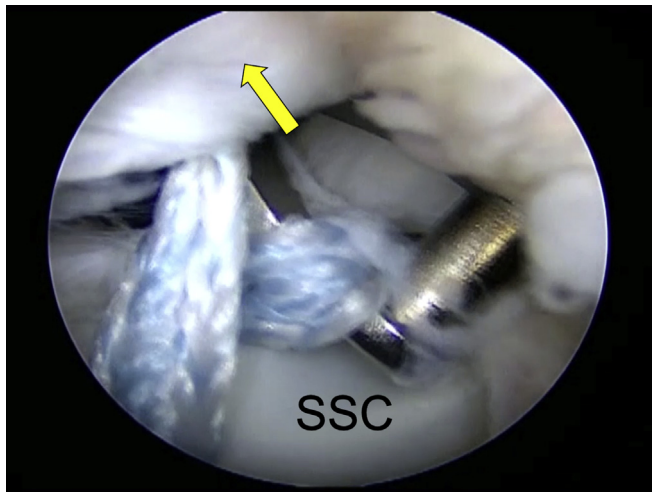

Fig 7. Left shoulder: Arthroscopic visualization through the posterior portal showing the 2 suture limbs retrieved through the anteroinferior portal (yellow arrow) using a FiberTape retriever through the 6-mm cannula to ensure no tissue bridge. (SSC, subscapularis tendon.)

both limbs of the FiberTape exiting the anteroinferior portal through the 6-mm cannula to ensure no tissue bridge. The 2 FiberTape limbs are then loaded into a 4.75-mm SwiveLock anchor (Arthrex) in standard fashion, and a clamp is placed on the free ends of the FiberTape sutures to hold the SwiveLock anchor at the ready for insertion. A punch is used to create a hole to receive the SwiveLock anchor, centered in the reverse Hill–Sachs bony lesion (Fig 8). The SwiveLock is then placed into the hole, sutures tensioned to pull the subscapularis tendon into the prepared bony defect, and then the suture anchor is impacted into place

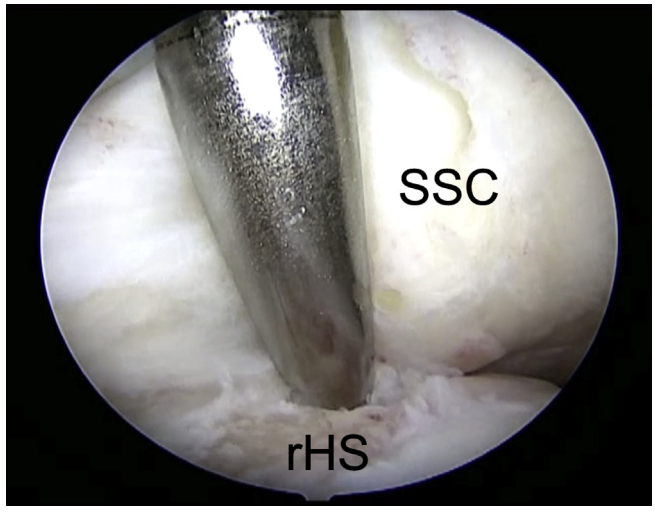

Fig 8. Left shoulder: Arthroscopic visualization through the posterior portal showing the punch used to create a hole to receive the SwiveLock anchor, centered in the reverse Hill–Sachs bony lesion. (rHS, reverse Hill–Sachs lesion; SSC, subscapularis tendon.)

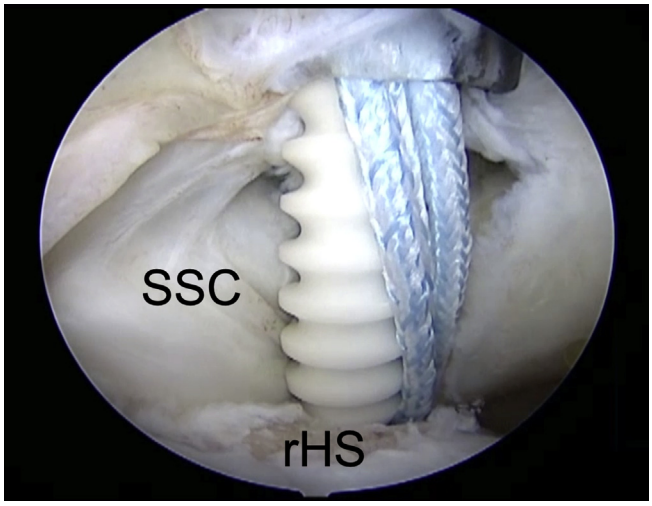

Fig 9. Left shoulder: Arthroscopic visualization through the posterior portal showing the SwiveLock placed into the hole, sutures tensioned to pull the subscapularis tendon into the prepared bony defect. (rHS, reverse Hill–Sachs lesion; SSC, subscapularis tendon.)

(Fig 9). Of note, for larger lesions, additional FiberTape sutures can be passed through the subscapularis tendon or a double-row construct can be created with FiberTape inserted into a SwiveLock anchor into the reverse Hill–Sachs lesion and passed transtendinously before being fixed through additional SwiveLock anchor(s) within the defect. After fixation is complete, the sutures are cut flush (Fig 10), and a dynamic arthroscopic examination can be performed to confirm that the reverse Hill–Sachs lesion no longer engages the posterior glenoid rim.

Discussion

In this manuscript, we present a detailed description of a technique for performing an arthroscopic knotless modified McLaughlin procedure that is easily reproducible and can be modified for applicability to reverse Hill–Sachs lesions of a variety of sizes based on the number of FiberTape sutures or anchors used in the construct. The modified McLaughlin procedure can be used as an adjunct procedure in the setting of posterior shoulder instability, that when paired with posterior Bankart repair or posterior capsulorrhaphy, can provide more comprehensive treatment of posterior shoulder instability.

Although posterior shoulder instability is rare in comparison with anterior shoulder instability,[9] reverse Hill–Sachs lesions are quite common in the setting of posterior shoulder dislocation, with a reported incidence of 30% in one systematic review and as high as 86% in one case series.[10,11] A recent biomechanical study identified size and location risk factors for engagement of these lesions on the posterior glenoid rim with internal rotation and posterior translation forces and suggested the use of the gamma angle, which measures the degree arc from the medial aspect of the reverse Hill–Sachs lesion to the anterior aspect of the bicipital grove, to predict which lesions would engage.[12,13] Engaging reverse Hill–Sachs lesions are problematic and if unaddressed can result in recurrent shoulder instability.[14]

Reverse Hill–Sachs lesions can be addressed by either anatomic or nonanatomic surgical procedures. Anatomic procedures are those which attempt to restore the anatomic shape of the humeral head and include bone grafting and disimpaction procedures, whereas nonanatomic procedures include rotational osteotomies and the more commonly used transfer/transposition procedures that use transfer of the subscapularis tendon or lesser tuberosity to fill the bony defect. Nonanatomic procedures remain the gold standard for reverse Hill–Sachs lesions smaller than 33% of the humeral head.[14,15] The first described nonanatomic procedure to address a reverse Hill–Sachs lesion was the McLaughlin procedure, which involved detachment of the subscapularis insertion from the humeral head and suture fixation of the tendon into the reverse Hill–Sachs defect.[16] This procedure was later modified by Hawkins et al.,[3] who performed a lesser tuberosity osteotomy, Charalambous et al.,[17] who used the subscapularis tendon to fill the void without tendon detachment, and Krackhardt et al.,[18] who first introduced an arthroscopic technique. We have previously described an arthroscopic technique for subscapularis remplissage using a 2-suture anchor construct requiring tying of arthroscopic knots,[1] but with the advancement

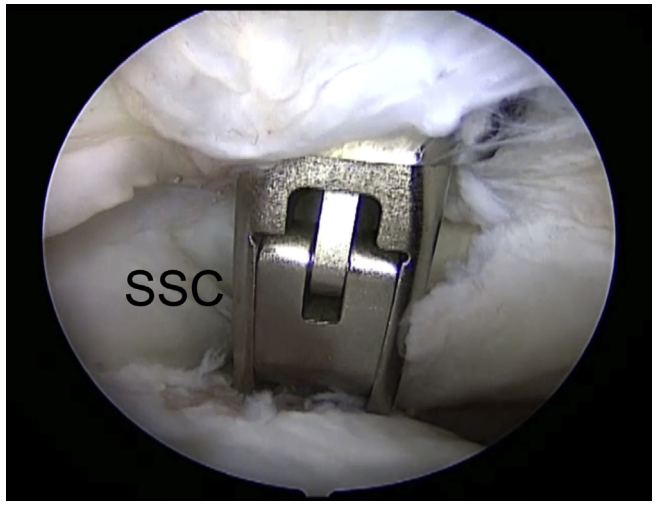

Fig 10. Left shoulder: Arthroscopic visualization through the posterior portal showing of the final fixation. The sutures are cut flush and a dynamic arthroscopic examination can be performed to confirm that the reverse Hill–Sachs lesion no longer engages the posterior glenoid rim. (SSC, subscapularis tendon.)

of arthroscopic techniques and implants, it is now possible to perform a modified McLaughlin procedure using a knotless technique. Knotless anchors afford the ability of a more efficient surgery and may offer a biomechanically sounder construct, as it eliminates tied knots as a weak point in the construct.

This manuscript is a Technical Note and as such, has a limited scope without comment on clinical results of the described technique. Unfortunately, there is a paucity of reported outcomes on any arthroscopic modified McLaughlin techniques, and further study is needed to better evaluate the clinical efficacy of these procedures.

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